

Commonly Encountered Ions in Chemistry

(Adapted from General Chemistry Laboratory Manual of the Institute of Chemistry, UP Diliman)

CATIONS

Monovalent – cations with +1 charge

Name	Stock Method	Symbol	Remarks
Ammonium	--	NH_4^+	Most common polyatomic cation (a cation made up of more than 1 atom)
Hydrogen	--	H^+	Common to all acids
Hydronium	--	H_3O^+	The product when water is protonated by an acid, i.e., $\text{H}_2\text{O} + \text{H}^+ \rightarrow \text{H}_3\text{O}^+$
Potassium	--	K^+	Salts of these ions are <i>generally</i> soluble
Sodium	--	Na^+	
Lithium	--	Li^+	
Silver	--	Ag^+	A colorless ion that is used in developing films
Cuprous	Copper (I)	Cu^+	A relatively unstable ion which easily gets converted to Cu^{2+}
Aurous	Gold (I)	Au^+	

Divalent – cations with +2 charge

Name	Stock Method	Symbol	Remarks
Magnesium	--	Mg^{2+}	Major components of hard water
Calcium	--	Ca^{2+}	
Zinc	--	Zn^{2+}	Required by some enzymes (biological catalysts) to properly function; produces amphoteric (can act both as an acid or a base) hydroxide
Strontium	--	Sr^{2+}	Can bio-accumulate by replacing calcium in the bone
Manganous	Manganese (II)	Mn^{2+}	A faint pink-colored ion
Cadmium	--	Cd^{2+}	Toxic metal; cause of Itai-itai disease (a disease where the sternum breaks easily)
Mercurous	Mercury (I)	Hg_2^{2+}	Toxic metals
Mercuric	Mercury (II)	Hg^{2+}	
Plumbous	Lead (II)	Pb^{2+}	
Ferrous	Iron (II)	Fe^{2+}	The metal ion found in the de-oxygenated haemoglobin
Cupric	Copper (II)	Cu^{2+}	A blue-colored ion
Nickelous	Nickel (II)	Ni^{2+}	An apple green-colored ion
Cobaltous	Cobalt (II)	Co^{2+}	A pink-colored ion
Stannous	Tin (II)	Sn^{2+}	
Barium	--	Ba^{2+}	Toxic when ingested
Platinum	Platinum (II)	Pt^{2+}	

Trivalent – cations with +3 charge

Name	Stock Method	Symbol	Remarks
Aluminum	--	Al ³⁺	Primary component of antiperspirants; produces amphoteric hydroxide
Antimonous	Antimony (III)	Sb ³⁺	Toxic heavy metal
Arsenous	Arsenic (III)	As ³⁺	
Chromic	Chromium (III)	Cr ³⁺	A green-colored ion; produces amphoteric hydroxide
Cobaltic	Cobalt (III)	Co ³⁺	
Nickelic	Nickel (III)	Ni ³⁺	
Ferric	Iron (III)	Fe ³⁺	When prepared from FeCl ₃ , the ion appears yellow in color but when isolated, the ion is actually faint purple in color
Auric	Gold (III)	Au ³⁺	
Antimonous	Antimony (III)	Sb ³⁺	
Bismuthous	Bismuth (III)	Bi ³⁺	

Tetravalent – cations with +4 charge

Name	Stock Method	Symbol	Remarks
Stannic	Tin (IV)	Sn ⁴⁺	
Platinum	Platinum (IV)	Pt ⁴⁺	
Plumbic	Lead (IV)	Pb ⁴⁺	
Manganic	Manganese (IV)	Mn ⁴⁺	

Pentavalent – cations with +5 charge

Name	Stock Method	Symbol	Remarks
Antimonic	Antimony (V)	Sb ⁵⁺	
Arsenic	Arsenic (V)	As ⁵⁺	
Bismuthic	Bismuth (V)	Bi ⁵⁺	

ANIONS

Ions with -1 charge

Name	Other Name(s)	Symbol	Remarks
Acetate	--	CH ₃ COO ⁻	The ion present in acetic acid, CH ₃ COOH which is the acidic component of vinegar
Hydroxide	--	OH ⁻	Produces basic solution when present in water
Fluoride	--	F ⁻	Helps prevent cavities; one of the active ingredients in toothpaste
Chloride	--	Cl ⁻	Found in table salt
Bromide	--	Br ⁻	As its potassium salt, i.e. KBr, it can be

			used as an anti-convulsant and sedative
Iodide	--	I ⁻	The ion added in iodized salt
Cyanide	--	CN ⁻	When acidified, i.e., $H^+ + CN^- \rightarrow HCN$, HCN is a toxic gas used in gas chambers
Cyanate	--	OCN ⁻	
Thiocyanate	--	SCN ⁻	
Dihydrogen phosphate	Monobasic phosphate	H ₂ PO ₄ ⁻	
Hydrogen carbonate	Bicarbonate	HCO ₃ ⁻	Component of baking soda
Hydrogen sulfate	Bisulfate	HSO ₄ ⁻	
Hydrogen sulfite	Bisulfite	HSO ₃ ⁻	
Hydride	--	H ⁻	A very strong reducing agent (can easily transfer its electrons to its partner reactant)
Hypohalite	--	XO ⁻	Where X = Cl, Br, or I
Halite	--	XO ₂ ⁻	
Halate	--	XO ₃ ⁻	
Perhalate	--	XO ₄ ⁻	
Nitrite	--	NO ₂ ⁻	N ₂ are fixed by <i>Nitrosomas</i> into this ion during nitrogen cycle
Nitrate	--	NO ₃ ⁻	When paired with NH ₄ ⁺ and fuel, can be used as explosive
Permanganate	Tetraoxomanganate (VII)	MnO ₄ ⁻	Highly oxidizing; can cause chemical burns and suspected mutagen (mutation-causing)
Superoxide	--	O ₂ ⁻	

Ions with -2 charge

Name	Other Name(s)	Symbol	Remarks
Carbonate	--	CO ₃ ²⁻	Major component of soda ash
Sulfate	--	SO ₄ ²⁻	Together with Ba ²⁺ , i.e. BaSO ₄ , it is used as a contrast agent to visualize the gastrointestinal tract for X-ray
Sulfite	--	SO ₃ ²⁻	
Thiosulfate	--	S ₂ O ₃ ²⁻	An ion similar to sulfate with one of the oxygen atom replaced by a sulfur atom; used in hair straightening
Tetrathionate	--	S ₄ O ₆ ²⁻	An oxidation product of thiosulfate
Peroxysulfate	--	S ₂ O ₈ ²⁻	
Oxalate	--	C ₂ O ₄ ²⁻	Hepatotoxic (toxic to the kidneys) as it induces the production of kidney stones
Chromate	Tetraoxochromate	CrO ₄ ²⁻	A yellow-colored ion that is strongly

	(VI)		oxidizing (can easily accept electron from its partner reactant)
Dichromate	--	$\text{Cr}_2\text{O}_7^{2-}$	An orange-colored ion that is formed by acidification of the chromate ion, i.e. $2 \text{CrO}_4^{2-} + 2 \text{H}^+ \rightarrow \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$
Hydrogen phosphate	Biphosphate; Dibasic phosphate	HPO_4^{2-}	
Oxide	--	O^{2-}	Very common among metallic ores
Sulfide	--	S^{2-}	
Molybdate	Tetraoxomolybdenum (VI)	MoO_4^{2-}	
Tartrate	--	$\text{C}_4\text{H}_4\text{O}_6^{2-}$	
Peroxide	--	O_2^{2-}	

Ions with -3 charge

Name	Other Name(s)	Symbol	Remarks
Arsenate	--	AsO_4^{3-}	
Phosphate	Orthophosphate	PO_4^{3-}	
Phosphite	--	PO_3^{3-}	
Borate	--	BO_3^{3-}	
Arsenite	--	AsO_3^{2-}	
Antimonate	--	SbO_4^{3-}	
Aluminate	--	AlO_3^{3-}	
Nitride	--	N^{3-}	
Phosphide	--	P^{3-}	

Ions with -4 charge

Name	Other Name(s)	Symbol	Remarks
Pyrophosphate	--	$\text{P}_2\text{O}_7^{4-}$	

Writing Chemical Formula from Chemical Names and vice versa

Ionic Compounds

- Made up of a cation and an anion (often simplified as metal + non-metal. However, this definition should be used with extreme caution)
- Nomenclature: Name of cation + Name of anion
- In writing the formula, the charge of the cation becomes the subscript of the anion while the charge of the anion becomes the subscript of the cation.

Examples

From formula to name

NaCl

Cation name: Sodium ion

Anion name: Chloride

Compound name: **Sodium chloride**

(NH₄)₃PO₄

Cation name: Ammonium

Anion name: Phosphate (or orthophosphate)

Compound name: **Ammonium phosphate** or **Ammonium orthophosphate**

Note: As you can see, the name is **NOT** triammonium phosphate. It is because for ionic compounds, we do not use prefixes to denote the number of ions present in the compound.

Ni(ClO₂)₃

Cation name: Nickelic (or Nickel (III))

Anion name: Chlorite

Compound name: **Nickelic chlorite** or **Nickel (III) chlorite**

Note: The anion here is named chlorite because it is an XO₂⁻ ion (a halite; see *commonly used ion with -1 charge*) with X = Cl (hence hal- = chlor-).

From name to formula

Zinc acetate

Cation: Zn²⁺

Anion: CH₃COO⁻

Chemical formula: **Zn(CH₃COO)₂**

Note: The acetate is enclosed in parenthesis to denote that this group of atoms is taken collectively as one unit.

Copper (II) sulfate or **Cupric sulfate**

Cation: Cu^{2+}

Anion: SO_4^{2-}

Chemical formula: **CuSO_4**

Note: Instead of writing $\text{Cu}_2(\text{SO}_4)_2$, the formula is written with the subscript expressed in their simplest whole number ratio, i.e. 2:2 is simplified as 1:1. This is always done for ionic compounds (with the exception for Hg_2^{2+} because the ion exists as diatomic).

Mercury (I) bromide or **Mercurous bromide**

Cation: Hg_2^{2+}

Anion: Br^-

Chemical formula: **Hg_2Br_2**

Note: As seen in this example, the ratio is not expressed in lowest term because mercury (I) ion is diatomic (Hg_2^{2+}) and does **NOT** exist as Hg^+ .

Molecular Compounds

- Those containing covalent (polar or non-polar) bonds
- Often simplified as those composed only of non-metallic atom (but this is not always the case. Recall that C-Mg bond is polar covalent)
- Nomenclature: (prefix + name of 1st atom) (prefix + name of 2nd atom + ide)
- Prefixes used: mono (only used for the 2nd atom), di, tri, tetra, penta, hexa, hepta, octa, nona, deca

Examples

From formula to name

CO

1st atom: Carbon

2nd atom: Oxygen

Chemical name: **Carbon monoxide**

Note: Notice that the prefix mono was only used for the 2nd atom. Also, instead of writing monoxide, the other vowel is omitted.

BF₃

1st atom: Boron

2nd atom: Fluorine

Chemical name: **Boron trifluoride**



1st atom: Nitrogen

2nd atom: Oxygen

Chemical name: **Dinitrogen tetroxide**

Note: Notice that instead of writing tetraoxide, the vowel in the prefix is omitted.

From name to formula

Sulfur hexabromide

1st atom: Sulfur, prefix = none hence 1

2nd atom: Bromine, prefix = hexa hence 6

Chemical formula: **SF₆**

Diphosphorus tetroxide

1st atom: Phosphorus, prefix = di hence 2

2nd atom: Oxygen, prefix = tetra hence 4

Chemical formula: **P₂O₄**

Note: Notice that the subscripts need not be expressed in lowest terms (unlike those in ionic compounds).

Dihydrogen monoxide

1st atom: Hydrogen, prefix = di hence 2

2nd atom: Oxygen, prefix = mono hence 1

Chemical formula: **H₂O**

Common Names of Compounds

Common Name	Formula	IUPAC Name
ACIDS		
Aqua regia	HNO_3 and HCl (1:3 by volume)	Nitric acid + Hydrochloric acid
Aqua fortis	HNO_3	Nitric acid
Oil of vitriol	H_2SO_4	Sulfuric acid
Muriatic acid	HCl	Hydrochloric acid
BASES		
Lye/Caustic soda	NaOH	Sodium hydroxide
Caustic potash	KOH	Potassium hydroxide
Milk of Magnesia	$\text{Mg}(\text{OH})_2$	Magnesium hydroxide
Slaked lime	$\text{Ca}(\text{OH})_2$	Calcium hydroxide
SALTS		
Saltpeter	KNO_3	Potassium nitrate
Lime	CaO	Calcium oxide
Limestone	CaCO_3	Calcium carbonate
Plaster of Paris	$\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$	Calcium sulfate hemihydrate
Gypsum	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Calcium sulfate dihydrate
Epsom salt	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	Magnesium sulfate heptahydrate
Potash	K_2CO_3	Potassium carbonate
Galena	PbS	Lead sulfide
Lunar caustic	AgNO_3	Silver nitrate
Baking soda	NaHCO_3	Sodium bicarbonate or sodium hydrogen carbonate
Alumina	Al_2O_3	Aluminum oxide
Soda ash	Na_2CO_3	Sodium carbonate
COMPOUNDS		
Laughing gas	N_2O	Dinitrogen monoxide
Freon	CCl_2F_2	Dichlorodifluoromethane
Dry ice	CO_2 (solid)	Solid carbon dioxide